

Optionally, conduit wall 34 adjacent puncturing needle 33 can be thickened to provide support.

In yet another embodiment, as shown in FIGS. 14 and 15, cutting edge 29 can be a blade surface extension 35. Blade surface extension 35 can have a twist angle of between about 0° and less than about 180°. Preferably, the twist angle of blade surface extension 35 is about 90°, for the reasons given previously. Extension 35 can blend into the structure of the cylindrical tube 16; that is, extension 35 tapers to nothing along the longitudinal axis of the conduit.

FIGS. 11, 12 and 13 show additional embodiments of the guide means 14 and valve means 21. A circular lip 36 of valve means 21 is joined to a mating circular flange 37 formed from the wall of guide means 14. Flange 37 can be adjacent the mouth of the guide means.

Conduit 10 can be of any suitable size depending upon parameters such as stopper material, stopper diameter, pipette stem length and diameter, etc. Conventionally, conduit 10 can be approximately  $\frac{1}{4}$  to  $\frac{3}{8}$  inch in inside diameter at mouth 13, and decrease uniformly in diameter to approximately  $\frac{1}{8}$  inch in inside diameter at tube 16. Tube 16 can be about one inch in length with a wall thickness of about 1/16 inch.

Conduit 10 can be thermoformed from an acetyl or other thermoplastic which will permit molding of sharp edges at the beveled tip, which will remain sharp over time. The conduit can be made from a styrene such as ABS (acrylonitrile butadiene styrene).

Conduit 10 is inserted through a stopper 19 by puncturing stopper 19 with the beveled tip 17 of conduit 10. Pipette stem 12 is then inserted through the duck bill valve of conduit 10 and fluid 32 is aspirated from tube 20 into the pipette. Alternately, fluid can be dispensed into the sample tube from the pipette. Finally, pipette stem 12 is withdrawn from conduit 10. Duck bill valve 21 provides reentrant capability.

To help prevent coring of the cap, the cap can be scored before puncture by the conduit. Scoring involves the marking or "scoring" of the stopper with a sharp object. The cut or shallow slit thereby made in the cap stopper can assist initial puncturing by the conduit and also assist passage of the conduit through a cap stopper without coring.

In use, resealable conduit 10 is positioned over the top of a conventional physiological fluid collection tube 20. Tube 20 can contain any of a variety of physiological or nonphysiological fluids. As tube 20 is either brought to the conduit 10 or conduit 10 is brought to tube 20, tip 17 contacts the top of stopper 19.

The present invention also includes within its scope an apparatus comprising a conduit 10, pipette 11 and a sample tube stopper 19 or any combination of these components, with or without insertion of the conduit 10 through the stopper 19.

Any septum-type closures that can be pierced to gain access to a closed system on a repeatable and resealable basis are suitable for the present conduit 10. The resealable conduit renders unnecessary removal of the stopper of a sample tube to access fluid contained by the stoppered tube. The conduit allows essentially aseptic removal of fluid on a repeatable basis. The present invention is inserted through a stopper and remains, in part, exterior to the stopper.

The disclosed resealable conduit can be used manually or as part of an automated procedure. In a manual operation, the user presses the puncture means through

the septum of a closed system, followed by insertion of a tubular member into the conduit. Fluid can be added to or removed from the closed system through the tubular member, typically a pipette stem.

Alternately, or in conjunction with one or more manually effected steps, the puncture means of the conduit can be inserted through the septum or stopper in a machine-assisted step. When used in an automated procedure, the tubular member can be a pipette or a probe component of a stand-alone or workstation instrumentation. For example, the resealable conduit can be used in conjunction with the Beckman Synchron Clinical Analyzers, such as the Beckman CX-5.

Significant advantages of the invention include:

1. Non-coring penetration of a rubber or like-material stopper by the conduit;
2. A conduit that is resealable, with one-way mechanical access and that prevents fluid backflow;
3. Re-entrant conduit capability;
4. Low-friction access to sample by a pipette or other tubular member;
5. Disposable, resealable conduit;
6. Essentially biohazard-free operator interaction; and
7. Essentially biohazard-free serum (or other physiological or nonphysiological fluid) transfer.

The resealable conduit provides a solution to the problem of aseptically violating the cap of a sample tube in order to repeatably remove fluid, such as a physiological fluid from the tube without the creation of aerosols, biohazards or exposing the blood products to the exterior environment without containment. The conduit is constructed inexpensively so as to be a disposable device.

Although several embodiments of the invention have been disclosed, it should be understood that the present invention is in no way limited thereby and that its scope is to be determined by the appended claims.

We claim:

1. A resealable conduit, comprising:
  - (a) a conduit bore having first and second ends;
  - (b) a funnel-shaped guide means being a mouth at the first end of the conduit bore for receiving and guiding a leading end of an elongated tubular member;
  - (c) puncturing means at the second end of the conduit bore;
  - (d) valve means disposed within the guide means, the valve means having an upper portion and a lower portion and having a continuous and integral funnel-shaped cross-section which is substantially similar to the funnel-shaped cross-section of the guide means and comprising a plurality of movable leaflets, the leaflets being made of resilient material, the leaflets extending inwardly from the mouth of the guide means, and the leaflets having ends remote from the mouth, the ends being in point to point engagement to close the valve means and point to point non-engagement to open the valve means and wherein the valve means at its lower portion does not rest on the conduit bore, and the leaflets are movable between the open and closed positions without engaging the conduit bore; and
  - (e) the guide means being wider than the bore at the second end, and the guide means being directed so that the leading end of the elongated tubular member is removably insertable through the valve means.